

REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-50, 52-65 and 78 are presently active in this case, Claims 66-77 canceled and Claim 78 added by way of the present amendment. Claims 1 and 61-63 amended by way of the present amendment.

In the outstanding Official Action, the restriction requirement was made final and Claims 14-19, 39-50, 53-57 and 65-77 were withdrawn from further consideration; the oath or declaration was objected to; Claims 61 and 62 were objected to for minor informalities; Claims 1-4, 6, 11-13, 20-23, 27, 28, 31, 34-36, 51 and 52 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent 6,420,279 to Ono et al.; Claims 1-4, 6, 7, 11-13, 20, 23, 25-27, 31-33, 51 and 52 were rejected under 35 U.S.C. §102(a) or (e) as being anticipated by U.S. Patent 6,465,371 to Lim; Claims 1, 4, 6-8, 10, 11, 20-23, 27, 28, 31-33, 38 and 51 were rejected under 35 U.S.C. §102(a) or (e) as being anticipated by U.S. Patent 6,475,276 to Elers et al.; and the remaining active claims in this case were rejected under 35 U.S.C. §103(a) as being obvious over various combinations of the above cited references with U.S. Patent Publication 2003/0031793 to Chang et al., U.S. Patent 6,346,477 to Kaloyeros et al., U.S. Patent Publication 2001/0054769 to Raaijmakers et al., U.S. Patent 6,042,652 to Hyun et al., U.S. Patent 6,572,705 to Suntola et al., U.S. Publication 2003/0134038 to Paranjpe, U.S. Patent 6,607,973 to Jeon, U.S. Patent Publication 2002/0157611 to Bondestam et al., U.S. Patent 6,818,517 to Maes, U.S. Patent Publication 2002/0182320 to Leskela et al., U.S. Patent Publication 2003/0049372 to Cook et al., U.S. Patent 2002/0182320 to Leskela et al..

First, Applicants wish to thank Examiner Markham for the January 20, 2006 telephone discussion at which time the outstanding issues in this case were discussed. During

the interview, Applicants presented amendments and arguments substantially as indicated in this response. While no formal agreement was reached, Examiner Markham indicated that the amendments appear to overcome the outstanding rejection, but further consideration would be given upon formal filing of a response.

With regard to the objection to the Declaration, submitted herewith is a Supplemental ADS submitted to correct a typographical error in the Declaration filed February 9, 2004. Specifically, the Declaration indicated that the present application was filed on September 15, 2003, rather than September 16, 2003. The supplemental ADS clarifies that the present application was filed on September 16, 2003. Therefore the objection to the Declaration is believed to be overcome.

With regard to the objection to Claims 61 and 62, Applicants have amended these claims to correct the informalities noted in the Office Action. Thus the objection to Claims 61 and 62 are believed to be overcome.

Turning now to the merits, in order to expedite issuance of a patent in this case, Applicants have amended independent Claim 1 to clarify the patentable features of the present invention over the cited references. Specifically, Applicants' Claim 1, as amended recites a method of forming a metal containing film on a substrate the method including providing a plurality of substrates on respective surfaces of a tier substrate holder in a process chamber of a batch type processing system, and heating the substrates to a predetermined temperature where film deposition rate is independent of temperature. Also recited is flowing a pulse of metal containing precursor in the process chamber, flowing a pulse of a reactant gas in the process chamber, and repeating the flowing processes until a metal containing film with desired film properties is formed on the substrates.

Thus, Applicants' independent Claim 1 has been amended to clarify that a plurality of substrates are provided on respective surfaces of a tier substrate holder in a process chamber,

and further that the substrates are heated to a predetermined temperature where a film deposition rate is independent of temperature. As discussed in the January 20<sup>th</sup> interview, the formation of metal containing high-K films has generally been limited to single substrate processes, which will not provide a cost effective mechanism for integrating such films with semiconductor devices. While formation of such films on multiple wafers in the batch processing system has gone unstudied due to the difficult problem of providing uniform process results at different wafer positions in the process chamber, the present inventors have conducted experiments to analyze the effect of different batch type process parameters when depositing metal containing high-K films. As shown in Figures 12A and 12B and 13 of the present application, the present inventors discovered that heating the plurality of substrates to a temperature where a film deposition rate is independent of temperature can provide improved uniformity of metal containing high K films throughout the batch. Claim 1 has been amended to clarify this feature.

In contrast, the primary cited references to Ono et al., Elers et al., and Leem do not disclose a batch processing system at all. Specifically, the cited reference to Ono et al. discloses an ALD process with respect to a single semiconductor substrate in an ALD chamber.<sup>1</sup> There is no mention of a batch processing system at all in Ono et al. Similarly, Elers et al. discloses an ALD process with respect to chemical compounds used in the process, and does not mention a batch type processing system. While Example 1 of Elers et al. explains that a 50 mm square piece of silicon wafer and a 50 mm square piece of glass substrate are loaded into an ALD reactor, as discussed in the January 20<sup>th</sup> interview these substrates appear to be loaded at separates times within an ALD reactor. Even assuming that the substrates are loaded at the same time in the ALD reactor for simultaneous processing, the substrates would likely be provided side-by-side on a single substrate holder. Thus, Elers et

---

<sup>1</sup> See Figures 1 and 2 at steps 110 and 220.

al. also does not disclose a batch type processing system. Finally, the cited reference to Leem discloses a single substrate 12 provided in a single substrate process chamber 10.

Thus, the cited references to Ono et al., Elers et al. and Leem do not disclose providing a plurality of substrates on respective surfaces of a tier substrate holder in a process chamber of a batch type processing system as required by Claim 1. Further, Applicants note that none of these references disclose heating the substrates to a predetermined temperature where film deposition rate is independent of temperature. Thus, Claim 1, as amended cannot be anticipated by the primary set of references.

The secondary references do not make up the deficiencies of the primary references noted above. Of the twelve secondary references cited, the references to Hyun et al., Suntola et al., Paranjpe, Cook et al., and Leem appear to be the only cited references that suggest simultaneous processing of more than one substrate. However, the cited references to Hyun et al. and Suntola et al. disclose discrete chamber modules that are stacked on top of one another in order to provide discrete process chambers for respective substrates. Similarly, the cited reference to Leem discloses a process for depositing aluminum on a substrate provided on an upright substrate holder 102b, as well as a substrate suspended upside down on a on a top substrate holder 102a. Applicants submit that these configurations do not provide a plurality of substrates on respective surfaces of a tier substrate holder in a batch process chamber as now required by Claim 1. Moreover, these cited references do not suggest heating the substrates to a predetermined temperature where film deposition rate is independent of temperature.

The cited reference to Cook et al. appears to disclose a tier type substrate holder. However this reference discloses a CVD process, and not flowing a pulse of metal containing a precursor in the process chamber, and flowing a pulse of reacting gas in the process chamber as also required by Claim 1. Paranjpe also appears to disclose a tier substrate

holder, but this reference is silent as to whether or how the substrates are heated. Moreover, both Cook et al. and Paranjpe et al. are completely silent with respect to heating the substrates to a predetermined temperature where film deposition rate is independent of temperature.

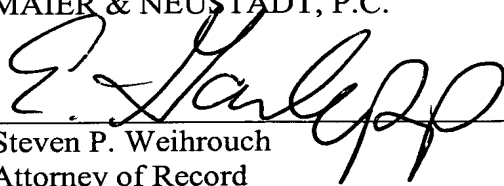
Thus, the primary cited references, and the most relevant secondary references each fail to disclose a feature relating to the type of batch process chamber which provides a backdrop for the present invention. More importantly, however, none of the cited references teach or suggest heating the plurality of substrates to a predetermined temperature where film deposition rate is independent of temperature as required by independent Claim 1. As such, the cited references cannot provide the uniform deposition of metal containing precursors that can be provided by the present invention. Thus, Applicants' Claim 1 and all claims depending therefrom patentably define over the cited references.

Finally, Applicants note that Claim 78 has been added to vary the scope of protection provided by the claims in this case. Specifically, Claim 78 recites that the flowing steps of Claim 1 provide a deposition rate of about 1 angstrom per cycle. Again, the present inventors have discovered that such a deposition rate can provide improved uniformity when depositing a metal containing film in a batch type processing system. The cited references also do not disclose this feature. Therefore, Claim 78 provides an additional basis for patentability of the cited references.

Consequently, in view of the present amendment, no further issues are believed to be outstanding in the present application and the present application is believed to be in condition for formal allowance. An early and favorable action is therefore respectfully requested.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,  
MAIER & NEUSTADT, P.C.



Steven P. Weihrouch  
Attorney of Record  
Registration No. 32,829

Customer Number  
**22850**

Tel: (703) 413-3000  
Fax: (703) 413 -2220  
(OSMMN 06/04)  
EDG/rac

Edwin D. Garlepp  
Registration No. 45,330

I:\ATTY\EDG\241482US-AM.DOC